

PATENT ABSTRACTS OF JAPAN

(11)Publication number : 11-020428

(43)Date of publication of application : 26.01.1999

(51)Int.Cl.

B60C 23/02
B60C 23/06

(21)Application number : 09-196567

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(22)Date of filing : 07.07.1997

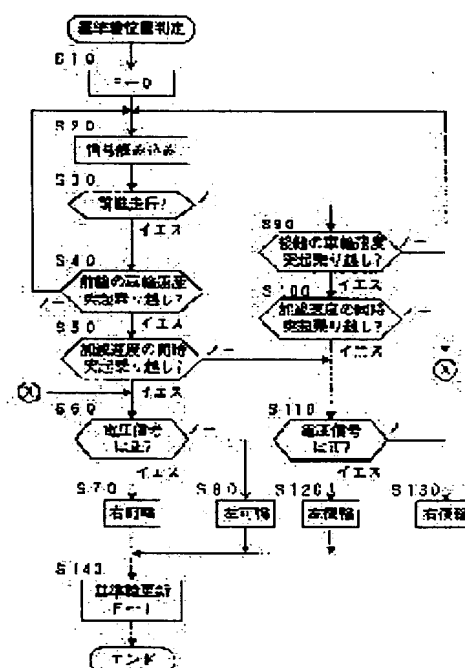
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(54) TIRE AIR PRESSURE ESTIMATING DEVICE FOR VEHICLE

(57)Abstract:

PROBLEM TO BE SOLVED: To accurately estimate tire air pressure of each wheel even during rotation of wheels.

SOLUTION: The traveling direction of a vehicle is judged (S30). Which one of front and rear wheels is a reference wheel is judged from the time correlation between a protrusion going-over time point based on wheel speed and a protrusion going-over time point based on acceleration-deceleration (S40, 50, 90, 100). Which one of the lateral wheels is a reference wheel is judged on the basis of a code of a voltage signal from an acceleration-deceleration sensor (S60-800 S100-130). Air pressure of other wheels is computed from the tire air pressure Pref of the position specified reference wheel, and the relation between the wheel speed Vwref of the reference wheel and the wheel speed of the other wheels to make an abnormality judgment (S240-290).



LEGAL STATUS

[Date of request for examination]

15.11.2000

[Date of sending the examiner's decision of rejection]

[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]

[Date of final disposal for application]

[Patent number]

3328552

[Date of registration]

12.07.2002

[Number of appeal against examiner's decision of rejection]

[Date of requesting appeal against examiner's decision of rejection]

[Date of extinction of right]

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CLAIMS

[Claim(s)]

[Claim 1] Whenever [tire-pressure detection means / which was formed in at least one criteria ring /, and wheel speed / which was prepared in each ring] A detection means, A means for it to be prepared in said criteria ring and to detect whenever [acceleration-and-deceleration / of said criteria ring] in the tire-pressure presumption equipment which has a means to presume the tire pressure of wheels other than said criteria ring based on whenever [tire-pressure / of said criteria ring /, and wheel speed / of each ring], Tire-pressure presumption equipment characterized by having a means to calculate whenever [acceleration-and-deceleration / of each ring] based on whenever [wheel speed / which was detected by the detection means whenever / said wheel speed], and a means to pinpoint the location of said criteria ring based on whenever [acceleration-and-deceleration / which and were calculated / which were detected]. [acceleration and deceleration]

[Claim 2] A means pinpoint the location of said criteria ring is tire-pressure presumption equipment according to claim 1 characterized by judging any of an order ring said criteria rings are based on the time correlation of whenever [acceleration-and-deceleration / which and were calculated / which were detected] while judging any of a right-and-left ring said criteria rings are based on the sign relation of whenever [acceleration-and-deceleration / which and were calculated / which were detected]. [acceleration and deceleration] [acceleration and deceleration]

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the tire-pressure presumption equipment of a vehicle, and relates to the tire-pressure presumption equipment which presumes the tire pressure of wheels other than a criteria ring based on whenever [at least one tire-pressure / of a criteria ring / and wheel speed / of each ring] in a detail further.

[0002]

[Description of the Prior Art] In vehicles, such as an automobile, since the ratio of a dynamic load radius is [whenever / wheel speed] equal to the inverse number of a ratio, if fixed relation between the ratios and the ratios of a dynamic load radius of the tire pressure of two wheels is, and the tire pressure of one wheel is known, based on a ratio, the tire pressure of other wheels can be presumed whenever [wheel speed / of the tire pressure and each ring].

[0003] As one of the tire-pressure presumption equipment based on this principle, it has a sensor whenever [tire-pressure sensor / which was formed in one wheel (criteria ring) /, and wheel speed / which was prepared in each ring], and the tire-pressure presumption equipment constituted so that the tire pressure of wheels other than a criteria ring might be presumed based on a ratio whenever [tire-pressure / of a criteria ring / and wheel speed / of each ring] is conventionally known as indicated by JP,6-191247,A.

[0004] Without preparing a pneumatic sensor in each ring, since the tire pressure of wheels other than a criteria ring is presumed based on whenever [tire-pressure / which was detected / and wheel speed / of each ring] about a criteria ring according to this tire-pressure presumption equipment, in order to control a slip of a wheel etc., whenever [wheel speed / which is prepared in each ring], using a sensor effectively, the tire pressure of all wheels can be presumed and the abnormality can be judged.

[0005]

[Problem(s) to be Solved by the Invention] Generally, since the main component parts of a sensor are attached in the wheel supporter material of a vehicle whenever [wheel speed], even if rotation of a wheel is performed, a sensor does not move whenever [wheel speed]. On the other hand, since a tire-pressure sensor is attached in the wheel of a being [it / necessary / to detect the pneumatic pressure of a tire] empty vehicle ring, if rotation of a wheel is performed, a tire-pressure sensor will move with the wheel.

[0006] Since it is the requisite that it is always in a certain specific location, for example, the location of a forward right ring, if rotation of a wheel is performed and an actual criteria ring moves to other wheel locations, it becomes impossible for the criteria ring in which the tire-pressure sensor was formed to presume the tire pressure of each ring correctly, and it will become impossible however, to judge the abnormalities of a tire pressure correctly in the conventional tire-pressure presumption equipment like ****.

[0007] This invention is made in view of the problem like **** in the conventional tire-pressure presumption equipment constituted so that the tire pressure of wheels other than a criteria ring might be presumed based on whenever [tire-pressure / of the criteria ring detected by the tire-pressure sensor /, and wheel speed / of each ring]. The main technical problems of this invention By pinpointing a criteria ring location and presuming the tire pressure of wheels other than a criteria ring based on the result, also when rotation of a wheel is performed, it is presuming the tire pressure of each ring correctly.

[0008]

[Means for Solving the Problem] A tire-pressure detection means by which the main technical problems like **** were prepared in the configuration of claim 1, i.e., at least one criteria ring, according to this invention. In the tire-pressure presumption equipment which has a means to presume the tire pressure of wheels other than said criteria ring based on whenever [detection means, tire-pressure / of said criteria ring /, and wheel speed / of each ring] whenever [wheel speed / which was prepared in each ring] A means for it to be prepared in said criteria ring and to detect whenever [acceleration-and-deceleration / of said criteria ring], and a means to calculate whenever [acceleration-and-deceleration / of each ring] based on whenever [wheel speed / which was detected by the detection means whenever / said wheel speed]. It is attained by the tire-pressure presumption equipment characterized by having a means to pinpoint the location of said criteria ring based on whenever [acceleration-and-deceleration / which and were calculated / which were detected]. [acceleration and deceleration]

[0009] Since the location of a criteria ring, i.e., the wheel in which the tire-pressure detection means was formed, is pinpointed based on whenever [acceleration-and-deceleration / which and were calculated / which were detected] according to the configuration of above-mentioned claim 1, [acceleration and deceleration] Even if a criteria ring is moved by performing rotation of a wheel, based on the tire pressure detected about the criteria ring after the migration, and whenever [wheel speed / of each ring], the tire pressure of wheels other than a criteria ring is presumed correctly.

[0010] According to this invention, that main above-mentioned technical problems should be attained effectively moreover, in the configuration of above-mentioned claim 1 While said criteria ring judges any of a right-and-left ring they are based on the

sign relation of whenever [acceleration-and-deceleration / which and were calculated / which were detected], a means to pinpoint the location of said criteria ring [acceleration and deceleration] It is constituted so that it may judge any of an order ring said criteria rings are based on the time correlation of whenever [acceleration-and-deceleration / which and were calculated / which were detected] (configuration of claim 2). [acceleration and deceleration]

[0011] If a criteria ring will be moved to a left wheel supposing a means to detect whenever [acceleration-and-deceleration] outputs the forward signal according to roll acceleration, when a criteria ring is a right wheel and the roll acceleration is the advance direction of a vehicle, as later explained to a detail, a means to detect whenever [acceleration-and-deceleration] will output the negative signal according to roll acceleration, when the roll acceleration of a criteria ring is the advance direction of a vehicle. However, if the roll acceleration of a criteria ring is the advance direction of a vehicle irrespective of whether a criteria ring is a right wheel or it is a left wheel, whenever [acceleration-and-deceleration / which are calculated based on whenever / wheel speed / which was detected by the detection means whenever / wheel speed] is forward. Therefore, based on the sign relation of whenever [acceleration-and-deceleration / which and were calculated / which were detected], it can judge any of a right-and-left ring criteria rings are. [acceleration and deceleration]

[0012] Moreover, if a front wheel overshoots its projection of a road surface etc., also whenever [acceleration-and-deceleration / which are calculated based on whenever / wheel speed / which was detected by the detection means whenever / wheel speed / of a front wheel] will change rapidly. When a criteria ring is a front wheel, and also whenever [acceleration-and-deceleration / which were detected] is substantially the same, it changes rapidly similarly, but when a criteria ring is a rear wheel, the same abrupt change of whenever [acceleration-and-deceleration / which were detected] is in a vehicle the time equivalent to a wheel base to carry out distance transit, and it generates it. Therefore, based on the time correlation of whenever [acceleration-and-deceleration / which and were calculated / which were detected], it can judge any of an order ring criteria rings are. [acceleration and deceleration]

[0013] Since according to the configuration of claim 2 it is judged any of an order ring criteria rings are while it is judged any of a right-and-left ring criteria rings are, even if a criteria ring is moved by performing rotation of a wheel, the location of the criteria ring after the migration is pinpointed correctly.

[0014]

[The desirable mode of a technical-problem solution means] According to one desirable mode of this invention, in above-mentioned claim 1 or the configuration of 2, a means to detect whenever [acceleration-and-deceleration] is constituted in [as a tire-pressure detection means] one (desirable mode 1).

[0015] According to one desirable mode of this invention, in above-mentioned claim 1 or the configuration of 2, a means to detect whenever [acceleration-and-deceleration] is constituted so that the roll acceleration of a criteria ring may be detected (desirable mode 2).

[0016] According to one desirable mode of this invention, in above-mentioned claim 1 or the configuration of 2, a means to calculate whenever [acceleration-and-deceleration / of each ring] based on whenever [wheel speed] is constituted so that whenever [acceleration-and-deceleration] may be calculated as a time amount differential value of whenever [wheel speed] (desirable mode 3).

[0017] Tire-pressure presumption equipment has a means detect the transit direction of a vehicle further, and according to one desirable mode of this invention, in the configuration of above-mentioned claim 2, a means pinpoint the location of a criteria ring is constituted so that it may judge any of a right-and-left ring criteria rings are based on the transit direction of a vehicle, and the sign relation of whenever [acceleration-and-deceleration / which and were calculated / which were detected] (desirable mode 4). [acceleration and deceleration]

[0018] According to one desirable mode of this invention, it sets in the configuration of above-mentioned claim 2. While a criteria ring judges any of a right-and-left ring they are based on the sign relation of whenever [acceleration-and-deceleration / which and were calculated / which were detected when a wheel overshoot its projection etc.], a means to pinpoint the location of a criteria ring [acceleration and deceleration] It is constituted so that it may judge any of an order ring criteria rings are based on the time correlation of whenever [acceleration-and-deceleration / which and were calculated / which were detected when a wheel overshoot its projection etc.] (desirable mode 5). [acceleration and deceleration]

[0019]

[Embodiment of the Invention] This invention is explained to a detail about a desirable operation gestalt, referring to drawing of attachment in the following.

[0020] The outline block diagram showing one operation gestalt of the tire-pressure presumption equipment of the vehicle according [drawing 1] to this invention and drawing 2 are the explanatory views showing relation with the sign of the output voltage of a sensor whenever [direction / in which the sensor was formed whenever / pneumatic-sensor and acceleration-and-deceleration / of the roll acceleration of a wheel /, and acceleration-and-deceleration].

[0021] In drawing 1, sensor 12floor line, 12FR, 12RL, and 12RR are prepared in forward left ring 10floor line, forward right ring 10FR, left rear ring 10RL, and right rear ring 10RR whenever [wheel speed / which detects Vwi (i=floor line, FR, RL RR) as a peripheral speed whenever / wheel speed / of the wheel which corresponds, respectively]. In the operation gestalt of illustration, forward right ring 10FR is set as the criteria ring, and it is the tire-pressure Pref in a forward right ring. It is Gw whenever [acceleration-and-deceleration / of the pneumatic sensor 14 which carries out direct detection and the hand of cut of a forward right ring]. The sensor 16 is formed whenever [acceleration-and-deceleration / to detect], and the sensor 16 is constituted in one with the pneumatic sensor 14 whenever [acceleration-and-deceleration].

[0022] The signal which shows [whenever / wheel speed] Vwi whenever [from sensor 12floor-line-12RR / wheel speed], the signal which shows the tire pressure PFR from a pneumatic sensor 14, and the signal which shows [whenever / acceleration-and-deceleration] GFR whenever [from a sensor 16 / acceleration-and-deceleration] are inputted into tire-pressure presumption equipment 18 as shown in drawing 1. Moreover, the signal which shows the shift position of transmission from the shift position sensor 20 is inputted into tire-pressure presumption equipment 18.

[0023] Tire-pressure presumption equipment 18 whenever [wheel speed] Vwi, a tire pressure PFR, While specifying the

wheel (criteria ring) in which the sensor 16 was formed whenever [pneumatic-sensor 14 and acceleration-and-deceleration] according to the routine shown in drawing 3 like the after-mentioned based on GFR and a shift position whenever [acceleration-and-deceleration] According to the routine shown in drawing 4 , the tire pressure P_i of wheels other than a criteria ring is calculated by presumption, and an alarm is emitted to the crew of a vehicle by outputting a control signal to an alarm 22 if needed.

[0024] In addition, tire-pressure presumption equipment 18 may have in fact a central-process unit (CPU), a read-only memory (ROM), the random access memory (RAM) backed up with the power source, and input/output port equipment, and may be the microcomputer to which these were mutually connected by the common bus of bidirection.

[0025] Criteria ring 10ref at the time of advance of a vehicle as shown in drawing 2 If a hand of cut is made into the direction of an arrow head A Whenever [acceleration-and-deceleration], the roll acceleration of a criteria ring looks at a sensor 16 from the outside of a vehicle, and when it is the direction of the circumference of a clock (the direction of an arrow head B), it outputs the forward voltage signal according to roll acceleration. When the roll acceleration of a criteria ring is the direction of the circumference of an anti-clock (the direction of an arrow head C), the negative voltage signal according to roll acceleration is outputted. Therefore, it is criteria ring 10ref by the sign of the voltage signal from a sensor 16 whenever [transit direction / of a vehicle / and acceleration-and-deceleration] as shown in the following table 1. It can judge whether it is a right wheel or it is a left wheel.

[0026]

[Table 1]

| 走行方向 | 電圧信号 | 基準輪 |
|------|------|-----|
| 前進 | 正 | 右輪 |
| 前進 | 負 | 左輪 |
| 後進 | 正 | 左輪 |
| 後進 | 負 | 右輪 |

[0027] moreover, it is shown in drawing 5 (A) -- as -- a criteria ring -- front-wheel 10F it is -- a case -- setting -- under advance transit of a vehicle 100 -- front-wheel 10F When overshooting one's projection 104 of a road surface 102 the time of the phenomenon of projection riding past of a front wheel being judged by whenever [acceleration-and-deceleration / which are calculated based on whenever / wheel speed / which was detected by sensor 12floor line or 12FR whenever / wheel speed / of a front wheel] as shown in drawing 5 (B) -- t1 It is t2 the time of the phenomenon of projection riding past being judged by the voltage signal from a sensor 16 whenever [acceleration-and-deceleration]. Substantially, when the same, it becomes. Therefore, when it is at the time when two times are substantially the same, it can judge with a criteria ring being a front wheel.

[0028] on the other hand, it is shown in drawing 6 (A) -- as -- a criteria ring -- rear wheel 10R In a case it is -- It is front-wheel 10F during advance of a vehicle 100. After overshooting one's projection 104 of a road surface 102, it is rear wheel 10R. When overshooting one's projection Even if the phenomenon of projection riding past of a front wheel is judged by whenever [acceleration-and-deceleration / which are calculated based on whenever / wheel speed / which was detected by sensor 12floor line or 12FR whenever / wheel speed / of a front wheel] as shown in drawing 6 (B) At the time, when substantially the same as that of t1, the phenomenon of projection riding past is not judged by the voltage signal from a sensor 16 whenever [acceleration-and-deceleration]. the time of the latter judgment being overdue time running the distance in which a vehicle is equivalent to a wheel base -- t3 the time of being carried out by setting, therefore not being at the time when the judgment of the phenomenon of both projection riding past is substantially the same -- a criteria ring -- rear wheel 10R it is -- ** -- it can judge.

[0029] in addition, when a wheel overshoots its projection in the situation that a vehicle goes astern Since it becomes contrary to the case where the physical relationship of a ring before and after receiving in the migration direction of a vehicle is advance of a vehicle, when it is at the time when the time of a judgment of the phenomenon of both projection riding past is substantially the same It can judge with a criteria ring being a rear wheel, and when it is not at the time when the time of being the judgment of the phenomenon of both projection riding past is substantially the same, it can judge with a criteria ring being a front wheel.

[0030] Next, with reference to the flow chart shown in drawing 3 and drawing 4 , a criteria ring location specification routine and a tire-pressure presumption routine are explained. In addition, these routines are started by closing of the ignition switch which is not shown in drawing, and the tire-pressure presumption routine shown especially in drawing 4 is repeatedly performed for every predetermined time amount.

[0031] In step 10 of a criteria ring location specification routine first shown in drawing 3 , the flag F which shows whether pinpointing of the location of a criteria ring was completed is reset by 0, and reading of the signal which shows V_{wi} whenever [wheel speed] in step 20 is performed. When distinction of whether a vehicle is in an advance run state based on the signal from the shift position sensor 20 in step 30 is performed and negative distinction is performed, it progresses to step 90, and when affirmation distinction is performed, it progresses to step 40.

[0032] When distinction of whether the forward left ring or the forward right ring overshoot their projection of a road surface based on the signal from sensor 12floor line or 12FR in step 40 whenever [wheel speed / of a right-and-left front wheel] is performed, negative distinction is performed and return and affirmation distinction are performed to step 20, it progresses to step 50. When distinction of whether the wheel in which the sensor was formed [whenever / acceleration-and-deceleration] whenever [acceleration-and-deceleration] based on the signal from a sensor 16 in step 50 overshoot its projection of a road surface to coincidence substantially with projection riding past of a front wheel is performed and negative distinction is performed, it progresses to step 110, and when affirmation distinction is performed, it progresses to step 60.

[0033] When the judgment of the purport whose forward right ring is a criteria ring is performed when distinction of whether the voltage signal from a sensor 16 is forward whenever [acceleration-and-deceleration] is performed in step 60 and

affirmation distinction is performed, and negative distinction is performed, in step 80, the judgment of the purport whose forward left ring is a criteria ring is performed.

[0034] When the respectively same distinction as steps 40 and 50 is performed and negative distinction is performed in step 100 in steps 90 and 100 about a rear wheel, it progresses to step 60, and when affirmation distinction is performed, it progresses to step 110.

[0035] When the judgment of the purport whose left rear ring is a criteria ring is performed in step 120 when the same distinction as the case of step 60, i.e., distinction of whether the voltage signal from a sensor 16 is forward whenever [acceleration-and-deceleration], is performed in step 110 and affirmation distinction is performed, and negative distinction is performed, in step 130, the judgment of the purport whose right rear ring is a criteria ring is performed.

[0036] While the information on the criteria ring stored in RAM of a microcomputer in step 140 is updated by steps 70 and 80,120 or the judgment result in 130, as it is shown that pinpointing of the location of a criteria ring was completed, Flag F is set to 1, and this routine is ended after an appropriate time.

[0037] In addition, it sets to the judgment of projection riding past based on the vehicle speed in steps 40 and 90. For example, whenever [based on whenever / wheel speed / acceleration-and-deceleration] calculates as a time amount differential value of whenever [wheel speed]. When whenever [this acceleration-and-deceleration] is beyond the reference value that is not generated at the time of the usual transit of a vehicle Or when the condition that whenever [based on whenever / wheel speed / acceleration-and-deceleration] is beyond a reference value continues beyond predetermined time amount Or it continues beyond time amount predetermined in the condition that whenever [based on whenever / wheel speed / acceleration-and-deceleration] is beyond a reference value, and when the differential value of whenever [based on whenever / wheel speed / acceleration-and-deceleration] is beyond a reference value, it may be judged with projection riding past.

[0038] In the judgment of projection riding past based on [whenever / acceleration-and-deceleration / in / similarly / steps 50 and 100] the signal from a sensor For example, when whenever [acceleration-and-deceleration / which were detected by the sensor 16 whenever / acceleration-and-deceleration] is beyond the reference value that is not generated at the time of the usual transit of a vehicle Or when the differential value which is whenever [acceleration-and-deceleration / by which the condition that whenever / acceleration-and-deceleration / which were detected / was beyond a reference value continued beyond predetermined time amount, and was detected when the condition that whenever / acceleration-and-deceleration / which were detected / is beyond a reference value continued beyond predetermined time amount] is beyond a reference value, it may be judged with projection riding past.

[0039] Moreover, it sets to step 210 of a tire-pressure presumption routine shown in drawing 4 . Reading of the signal which shows Vwi whenever [wheel speed] is performed, and Vwa calculates [whenever / wheel speed / of four flowers] whenever [average wheel speed] as the average of Vwi in step 220. It sets to step 230 and Vwa is for example, vehicle speed 5 km/h whenever [average wheel speed]. When distinction of whether to be beyond the corresponding reference value Vwo (forward constant) is performed, negative distinction is performed and return and affirmation distinction are performed to step 210, it progresses to step 240.

[0040] Value Pref with which the tire pressure of a criteria ring was detected by the pneumatic sensor 14 while Vwref was set up whenever [criteria wheel speed] according to the location of the criteria ring which was judged in steps 70 and 80,120,130 of a criteria ring location judging routine in step 240, and was updated in step 140 as shown in the following table 2 It is set up.

[0041]

[Table 2]

Criteria ring Whenever [criteria wheel speed] Tire-pressure forward right ring Vwref=VwFR PFR=Pref forward left ring Vwref=VwFL PFL=Pref right rear ring Vwref=VwRR PRR=Pref left rear ring Vwref=VwRL PRL=Pref [0042] Following several 1 is followed in step 250, and it is the tire pressure Pi of each ring other than a criteria ring. It calculates by presumption. [Equation 1] $P_i = (V_{wref}/V_{wi}) * Pref$ [0043] It sets to step 260 and is the pneumatic pressure Pi of a tire. When distinction of whether to be under the reference value Poi (forward constant) is performed, negative distinction is performed and return and affirmation distinction are sometimes performed to step 210, it progresses to step 270. Distinction of whether Flag F is 1 is performed in step 270. The control signal which operates an alarm 22 in step 280 when affirmation distinction is performed is outputted. An alarm 22 operates with the display of the purport in which the location of a criteria ring is not pinpointed in step 290 when the alarm of the purport that a tire pressure is unusual is emitted to the crew of a vehicle and negative distinction is performed. Thereby, the alarm of the purport that fear that a tire pressure is unusual is high is emitted to the crew of a vehicle. in addition, the step 260 — tire pressure Pi of all wheels ***** — step 270 is performed, when it is carried out and affirmation distinction is performed about at least one pneumatic pressure.

[0044] in this way — the criteria ring location judging routine of this operation gestalt — setting — step 30- or [that a criteria ring is a front wheel in the point mentioned above in connection with drawing 5 and drawing 6 in 50 and 90,100] — it is a rear wheel — since that judgment is performed and it is judged with combination with step 30, step 60, or step 110 any of a wheel on either side criteria rings are, the location of a criteria ring can be judged correctly.

[0045] Moreover, it sets to the tire-pressure presumption routine of this operation gestalt. According to the location of the criteria ring specified by the criteria ring location judging routine, the tire pressure of Vwref and a criteria ring is set up whenever [wheel speed / of a criteria ring] in step 240. Since the tire pressure of wheels other than a criteria ring calculates in step 250 according to the setup, even if a criteria ring is moved by the rotation of a wheel, the tire pressure of each ring can be calculated correctly and it can judge correctly whether a tire pressure is unusual.

[0046] Since steps 90 and 100 are performed at the time of go-astern transit of a vehicle and the judgment of the location of a criteria ring is especially performed according to the operation gestalt of illustration also at the time of go-astern of a wheel, the location of a criteria ring can be judged also at the time of go-astern of a vehicle. In addition, since the vehicle speed is low and the mileage is generally also short generally at the time of go-astern of a vehicle, when negative distinction is performed in step 30, return and steps 90 and 100 may be skipped to step 20.

[0047] Moreover, since according to the operation gestalt of illustration an alarm is outputted with a display to that effect when distinction of whether pinpointing of the location of a criteria ring is completed in step 270 is performed and pinpointing of the location of a criteria ring is not completed It compares, when pinpointing of the location of a criteria ring is not completed and an alarm is not outputted. The crew of a vehicle can recognize certainly that fear that which tire pressure is unusual is high. Moreover, when an alarm without the display of the purport to which pinpointing of a criteria ring location is not carried out is outputted, it can recognize certainly having judged that a tire pressure is unusual, after pinpointing of the location of a criteria ring was performed.

[0048] Furthermore, it can prevent certainly that these sensors of each other will be attached in another wheel even if the wheel was moved by the rotation of a wheel, since it was constituted whenever [acceleration-and-deceleration] in [a sensor 16 / as a pneumatic sensor 14] one according to the implementation gestalt of illustration, and, thereby, the location of a criteria ring can certainly be pinpointed.

[0049] Although this invention was explained above about the specific operation gestalt at the detail, probably this invention will not be limited to an above-mentioned operation gestalt, and it will be clear for this contractor its for other various operation gestalten to be possible within the limits of this invention.

[0050] For example, although it progresses to steps 110 and 60 as it is in the operation gestalt of illustration, respectively when negative distinction is performed in step 50 and step 100 When negative distinction is performed in steps 50 and 100 Time amount deltat which runs the distance in which a vehicle is equivalent to a wheel base based on H/Vwa, using the wheel base of a vehicle as H It calculates. It is deltat more substantially than the time of the judgment of projection riding past being performed based on whenever [wheel speed]. It distinguishes whether the judgment of projection riding past based on whenever [acceleration-and-deceleration] was performed after progress. When negative distinction is performed and return and affirmation distinction are performed to step 20, it may be corrected so that it may progress to steps 110 and 60, respectively.

[0051] Moreover, although renewal of the location of a criteria ring is performed in step 140 in the operation gestalt of illustration as it is when the judgment of the location of a criteria ring is performed in steps 70 and 80,120,130 When the predetermined number of judgments of the purport whose location of a criteria ring is the same location is performed in steps 70 and 80,120,130, it may be constituted so that renewal of the location of a criteria ring may be performed for the first time.

[0052] moreover, when distinction of step 230 is affirmation distinction It distinguishes whether distinction of whether Flag F is 1, i.e., pinpointing of the location of a criteria ring, is completed. When affirmation distinction is performed, progress to step 240, and it is constituted so that the wheel presumed that the wheel or tire pressure presumed that a tire pressure is the lowest based on a ratio whenever [between each wheel / wheel speed] when negative distinction is performed is the highest may be judged to be a criteria ring. Steps 270 and 290 of an operation gestalt may be skipped.

[0053] furthermore, when distinction of step 230 is affirmation distinction It distinguishes whether distinction of whether Flag F is 1, i.e., pinpointing of the location of a criteria ring, is completed. When affirmation distinction is performed, progress to step 240, and it is constituted so that the tire pressure of each ring may be correctly presumed in this technical field with the disturbance observer method or FFT (frequency analysis) method based on whenever [well-known wheel speed], when negative distinction is performed. Steps 270 and 290 of an operation gestalt may be skipped. Especially, in the case of a disturbance observer method, an observer may be initialized so that the average value of the tire pressure of four flowers presumed may be in agreement with the detection value of a pneumatic sensor 14.

[0054]

[Effect of the Invention] Since the location of the criteria ring after the migration is pinpointed according to the configuration of claim 1 of this invention even if a criteria ring is moved by performing rotation of a wheel so that more clearly than the above explanation, based on the tire pressure detected about a criteria ring, and whenever [wheel speed / of each ring], the tire pressure of wheels other than a criteria ring can be presumed correctly.

[0055] Moreover, since according to the configuration of above-mentioned claim 2 it is judged any of an order ring criteria rings are while it is judged any of a right-and-left ring criteria rings are, even if a criteria ring is moved by performing rotation of a wheel, the location of the criteria ring after the migration can be pinpointed correctly.

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] It is the outline block diagram showing one operation gestalt of the tire-pressure presumption equipment of the vehicle by this invention.

[Drawing 2] It is the explanatory view showing relation with the sign of the output voltage of a sensor whenever [direction / in which the sensor was formed whenever / pneumatic-sensor and acceleration-and-deceleration / of the roll acceleration of a wheel /, and acceleration-and-deceleration].

[Drawing 3] It is the flow chart which shows the criteria ring location judging routine in an operation gestalt.

[Drawing 4] It is the flow chart which shows the tire-pressure operation routine in an operation gestalt.

[Drawing 5] When a criteria ring is a front wheel, it is the explanatory view (A) and timing diagram (B) which show the situation that a front wheel and a rear wheel overshoot their projection of a road surface during advance of a vehicle at this order.

[Drawing 6] When a criteria ring is a rear wheel, it is the explanatory view (A) and timing diagram (B) which show the situation that a front wheel and a rear wheel overshoot their projection of a road surface during advance of a vehicle at this order.

[Description of Notations]

12floor-line-12RR -- Wheel speed sensor

14 -- Pneumatic sensor

16 -- It is a sensor whenever [acceleration-and-deceleration].

18 -- Tire-pressure presumption equipment

20 -- Shift position sensor

22 -- Alarm

[Translation done.]

(19) 日本国特許庁 (J P)

(12) 公開特許公報 (A)

(11) 特許出願公開番号

特開平11-20428

(43) 公開日 平成11年(1999) 1月26日

(51) IntCl.⁴
B 6 0 C 23/02
23/06

識別記号

F I
B 6 0 C 23/02
23/06

R
A

審査請求 未請求 請求項の数 2 F D (全 9 頁)

(21) 出願番号 特願平9-196567

(22) 出願日 平成9年(1997) 7月7日

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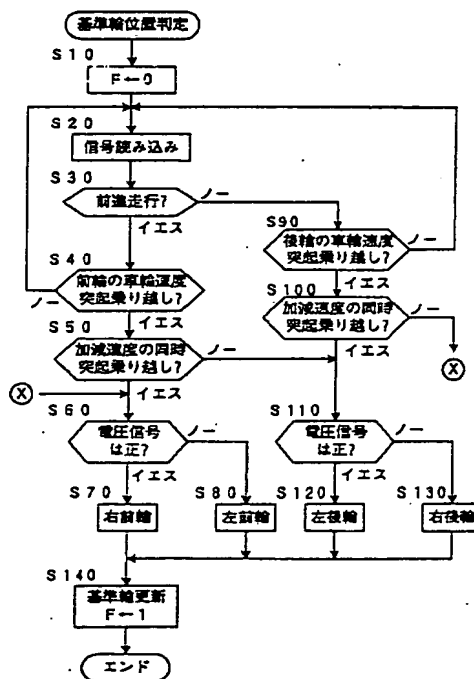
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(54) 【発明の名称】 車輛のタイヤ空気圧推定装置

(57) 【要約】

【目的】 車輪のローテーションが行われる場合にも各輪のタイヤ空気圧を正確に推定する。

【構成】 車輛の走行方向を判定し (S30)、車輪速度に基づく突起乗り越しの時点と加減速度に基づく突起乗り越しの時点との時間的相関関係により基準輪が前後輪の何れであるかを判定し (S40、50、90、100)、加減速度センサよりの電圧信号の符号に基づき基準輪が左右輪の何れであるかを判定する (S60~80、100~130)。そして位置が特定された基準輪のタイヤ空気圧 Pref 及び基準輪の車輪速度 Vwref と他の車輪の車輪速度との関係より他の車輪の空気圧を演算し異常判定を行う (S240~290)。



【特許請求の範囲】

【請求項 1】少なくとも一つの基準輪に設けられたタイヤ空気圧検出手段と、各輪に設けられた車輪速度検出手段と、前記基準輪のタイヤ空気圧と各輪の車輪速度とに基づき前記基準輪以外の車輪のタイヤ空気圧を推定する手段とを有するタイヤ空気圧推定装置に於いて、前記基準輪に設けられ前記基準輪の加減速度を検出する手段と、前記車輪速度検出手段により検出された車輪速度に基づき各輪の加減速度を演算する手段と、検出された加減速度及び演算された加減速度に基づき前記基準輪の位置を特定する手段とを有することを特徴とするタイヤ空気圧推定装置。

【請求項 2】前記基準輪の位置を特定する手段は検出された加減速度及び演算された加減速度の符号関係に基づき前記基準輪が左右輪の何れであるかを判定すると共に、検出された加減速度及び演算された加減速度の時間的相関関係に基づき前記基準輪が前後輪の何れであるかを判定することを特徴とする請求項 1 に記載のタイヤ空気圧推定装置。

【発明の詳細な説明】

【0001】

【発明の属する技術分野】本発明は、車輛のタイヤ空気圧推定装置に係り、更に詳細には少なくとも一つの基準輪のタイヤ空気圧と各輪の車輪速度とに基づき基準輪以外の車輪のタイヤ空気圧を推定するタイヤ空気圧推定装置に係る。

【0002】

【従来の技術】自動車等の車輛に於いては、二つの車輪のタイヤ空気圧の比とその動荷重半径の比との間には一定の関係があり、動荷重半径の比は車輪速度比の逆数に等しいので、一つの車輪のタイヤ空気圧が判れば、そのタイヤ空気圧と各輪の車輪速度比に基づき他の車輪のタイヤ空気圧を推定することができる。

【0003】かかる原理に基づくタイヤ空気圧推定装置の一つとして、例えば特開平 6 - 1 9 1 2 4 7 号公報に記載されている如く、一つの車輪（基準輪）に設けられたタイヤ空気圧センサと、各輪に設けられた車輪速度センサとを有し、基準輪のタイヤ空気圧と各輪の車輪速度比とに基づき基準輪以外の車輪のタイヤ空気圧を推定するよう構成されたタイヤ空気圧推定装置が従来より知られている。

【0004】かかるタイヤ空気圧推定装置によれば、基準輪について検出されたタイヤ空気圧及び各輪の車輪速度に基づき基準輪以外の車輪のタイヤ空気圧が推定されるので、各輪に空気圧センサを設けることなく、また車輪のスリップ等を制御するために各輪に設けられている車輪速度センサを有効に利用して、全ての車輪のタイヤ空気圧を推定しその異常を判定することができる。

【0005】

【発明が解決しようとする課題】一般に、車輪速度セン

サの主要な構成部品は車輛の車輪支持部材に取り付けられるので、車輪のローテーションが行われても車輪速度センサは移動しない。これに対しタイヤ空気圧センサはタイヤの空気圧を検出する必要があることから車輪のホイールに取り付けられるので、車輪のローテーションが行われるとタイヤ空気圧センサはその車輪と共に移動してしまう。

【0006】しかるに上述の如き従来のタイヤ空気圧推定装置に於いては、タイヤ空気圧センサが設けられた基準輪は常に或る特定の位置、例えば右前輪の位置にあることが前提になっているため、車輪のローテーションが行われ実際の基準輪が他の車輪位置へ移動すると、各輪のタイヤ空気圧を正確に推定することができなくなり、タイヤ空気圧の異常を正確に判定することができなくなってしまう。

【0007】本発明は、タイヤ空気圧センサにより検出された基準輪のタイヤ空気圧と各輪の車輪速度とに基づき基準輪以外の車輪のタイヤ空気圧を推定するよう構成された従来のタイヤ空気圧推定装置に於ける上述の如き問題に鑑みてなされたものであり、本発明の主要な課題は、基準輪位置を特定しその結果に基づき基準輪以外の車輪のタイヤ空気圧を推定することにより、車輪のローテーションが行われる場合にも各輪のタイヤ空気圧を正確に推定することである。

【0008】

【課題を解決するための手段】上述の如き主要な課題は、本発明によれば、請求項 1 の構成、即ち少なくとも一つの基準輪に設けられたタイヤ空気圧検出手段と、各輪に設けられた車輪速度検出手段と、前記基準輪のタイヤ空気圧と各輪の車輪速度とに基づき前記基準輪以外の車輪のタイヤ空気圧を推定する手段とを有するタイヤ空気圧推定装置に於いて、前記基準輪に設けられ前記基準輪の加減速度を検出する手段と、前記車輪速度検出手段により検出された車輪速度に基づき各輪の加減速度を演算する手段と、検出された加減速度及び演算された加減速度に基づき前記基準輪の位置を特定する手段とを有することを特徴とするタイヤ空気圧推定装置によって達成される。

【0009】上記請求項 1 の構成によれば、検出された加減速度及び演算された加減速度に基づき基準輪、即ちタイヤ空気圧検出手段が設けられた車輪の位置が特定されるので、車輪のローテーションが行われることにより基準輪が移動されても、その移動後の基準輪について検出されるタイヤ空気圧と各輪の車輪速度とに基づき基準輪以外の車輪のタイヤ空気圧が正確に推定される。

【0010】また本発明によれば、上述の主要な課題を効果的に達成すべく、上記請求項 1 の構成に於て、前記基準輪の位置を特定する手段は検出された加減速度及び演算された加減速度の符号関係に基づき前記基準輪が左右輪の何れであるかを判定すると共に、検出された加減

速度及び演算された加減速度の時間的相関関係に基づき前記基準輪が前後輪の何れであるかを判定するよう構成される（請求項2の構成）。

【0011】後に詳細に説明する如く、基準輪が右輪でありその回転加速度が車輦の前進方向である場合に加減速度を検出する手段が回転加速度に応じた正の信号を出力するとすると、基準輪が左輪に移動されると、加減速度を検出する手段は基準輪の回転加速度が車輦の前進方向である場合に回転加速度に応じた負の信号を出力する。しかし基準輪が右輪であるか左輪であるかに拘らず、基準輪の回転加速度が車輦の前進方向であれば、車輪速度検出手段により検出された車輪速度に基づき演算される加減速度は正である。従って検出された加減速度及び演算された加減速度の符号関係に基づき、基準輪が左右輪の何れであるかを判定することができる。

【0012】また前輪が路面の突起等乗り越えすと、前輪の車輪速度検出手段により検出された車輪速度に基づき演算される加減速度も急激に変化する。基準輪が前輪である場合には、検出された加減速度も実質的に同一の時点に於いて同様に急激に変化するが、基準輪が後輪である場合には、検出された加減速度の同様の急激な変化は車輦がホイールベースに相当する距離走行する時間遅れて発生する。従って検出された加減速度及び演算された加減速度の時間的相関関係に基づき基準輪が前後輪の何れであるかを判定することができる。

【0013】請求項2の構成によれば、基準輪が左右輪の何れであるかが判定されると共に基準輪が前後輪の何れであるかが判定されるので、車輪のローテーションが行われることにより基準輪が移動されても、その移動後の基準輪の位置が正確に特定される。

【0014】

【課題解決手段の好ましい態様】本発明の一つの好ましい態様によれば、上記請求項1又は2の構成に於いて、加減速度を検出する手段はタイヤ空気圧検出手段と一体的に構成される（好ましい態様1）。

【0015】本発明の一つの好ましい態様によれば、上記請求項1又は2の構成に於いて、加減速度を検出する手段は基準輪の回転加速度を検出するよう構成される（好ましい態様2）。

【0016】本発明の一つの好ましい態様によれば、上記請求項1又は2の構成に於いて、車輪速度に基づき各輪の加減速度を演算する手段は車輪速度の時間微分値として加減速度を演算するよう構成される（好ましい態様3）。

【0017】本発明の一つの好ましい態様によれば、上記請求項2の構成に於いて、タイヤ空気圧推定装置は更に車輦の走行方向を検出する手段を有し、基準輪の位置を特定する手段は車輦の走行方向と検出された加減速度及び演算された加減速度の符号関係とに基づき基準輪が左右輪の何れであるかを判定するよう構成される（好ま

しい態様4）。

【0018】本発明の一つの好ましい態様によれば、上記請求項2の構成に於いて、基準輪の位置を特定する手段は車輪が突起等乗り越え際に検出された加減速度及び演算された加減速度の符号関係に基づき基準輪が左右輪の何れであるかを判定すると共に、車輪が突起等乗り越え際に検出された加減速度及び演算された加減速度の時間的相関関係に基づき基準輪が前後輪の何れであるかを判定するよう構成される（好ましい態様5）。

【0019】

【発明の実施の形態】以下に添付の図を参照しつつ、本発明を好ましい実施形態について詳細に説明する。

【0020】図1は本発明による車輦のタイヤ空気圧推定装置の一つの実施形態を示す概略構成図、図2は空気圧センサ及び加減速度センサが設けられた車輪の回転加速度の方向と加減速度センサの出力電圧の符号との関係を示す説明図である。

【0021】図1に於いて、左前輪10FL、右前輪10FR、左後輪10RL、右後輪10RRにはそれぞれ対応する車輪の車輪速度 V_{wi} ($i = FL, FR, RL, RR$) を周速として検出する車輪速度センサ12FL、12FR、12RL、12RRが設けられている。図示の実施形態に於いては、右前輪10FRが基準輪に設定されており、右前輪にはそのタイヤ空気圧 P_{ref} を直接検出する空気圧センサ14と、右前輪の回転方向の加減速度 G_w を検出する加減速度センサ16とが設けられており、加減速度センサ16は空気圧センサ14と一体的に構成されている。

【0022】図1に示されている如く、車輪速度センサ12FL～12RRよりの車輪速度 V_{wi} を示す信号、空気圧センサ14よりのタイヤ空気圧 P_{FR} を示す信号、加減速度センサ16よりの加減速度 G_{FR} を示す信号はタイヤ空気圧推定装置18へ入力される。またタイヤ空気圧推定装置18にはシフトポジションセンサ20よりトランスミッションのシフトポジションを示す信号が入力されるようになっている。

【0023】タイヤ空気圧推定装置18は、車輪速度 V_{wi} 、タイヤ空気圧 P_{FR} 、加減速度 G_{FR} 、シフトポジションに基づき、後述の如く図3に示されたルーチンに従って空気圧センサ14及び加減速度センサ16が設けられた車輪（基準輪）を特定すると共に、図4に示されたルーチンに従って基準輪以外の車輪のタイヤ空気圧 P_i を推定により演算し、必要に応じて警報装置22へ制御信号を出力することにより車輦の乗員に警報を発するようになっている。

【0024】尚タイヤ空気圧推定装置18は実際には例えば中央処理ユニット（CPU）と、リードオンリメモリ（ROM）と、電源にてバックアップされたランダムアクセスメモリ（RAM）と、入出力ポート装置とを有し、これらが双方向性のコモンバスにより互いに接続されたマイクロコンピュータであつてよい。

【0025】図2に示されている如く、車輛の前進時に於ける基準輪10refの回転方向を矢印Aの方向とすると、加減速度センサ16は基準輪の回転加速度が車輛の外側より見て時計廻り方向（矢印Bの方向）であるときには回転加速度に応じた正の電圧信号を出力し、基準輪の回転加速度が反時計廻り方向（矢印Cの方向）であるときには回転加速度に応じた負の電圧信号を出力する。従って下記の表1に示されている如く、車輛の走行方向及び加減速度センサ16よりの電圧信号の符号により基準輪10refが右輪であるか左輪であるかを判定することができる。

【0026】

【表1】

| 走行方向 | 電圧信号 | 基準輪 |
|------|------|-----|
| 前進 | 正 | 右輪 |
| 前進 | 負 | 左輪 |
| 後進 | 正 | 左輪 |
| 後進 | 負 | 右輪 |

【0027】また図5（A）に示されている如く、基準輪が前輪10Fである場合に於いて、車輛100の前進走行中に前輪10Fが路面102の突起104を乗り越すときには、図5（B）に示されている如く、前輪の車輪速度センサ12FL又は12FRにより検出された車輪速度に基づき演算される加減速度により前輪の突起乗り越しの現象が判定される時点t1と、加減速度センサ16よりの電圧信号により突起乗り越しの現象が判定される時点t2とが実質的に同一の時点になる。従って二つの時点が実質的に同一の時点であるときには、基準輪は前輪であると判定することができる。

【0028】これに対し図6（A）に示されている如く、基準輪が後輪10Rである場合に於いて、車輛100の前進中に前輪10Fが路面102の突起104を乗り越した後に後輪10Rが突起を乗り越すときには、図6（B）に示されている如く、前輪の車輪速度センサ12FL又は12FRにより検出された車輪速度に基づき演算される加減速度により前輪の突起乗り越しの現象が判定されても、その時点t1と実質的に同一の時点に於いては加減速度センサ16よりの電圧信号により突起乗り越しの現象は判定されず、後者の判定は車輛がホイールベースに相当する距離を走行する時間遅れた時点t3に於いて行われ、従って両者の突起乗り越しの現象の判定が実質的に同一の時点でないときには、基準輪は後輪10Rであると判定することができる。

【0029】尚車輛が後進する状況にて車輪が突起を乗り越す場合には、車輛の移動方向に対する前後輪の位置関係が車輛の前進の場合とは逆になるので、両者の突起乗り越しの現象の判定の時点が実質的に同一の時点であるときには、基準輪は後輪であると判定することができ、両者の突起乗り越しの現象の判定の時点が実質的に同一の時点でないときには、基準輪は前輪であると判定

することができる。

【0030】次に図3及び図4に示されたフローチャートを参照して基準輪位置特定ルーチン及びタイヤ空気圧推定ルーチンについて説明する。尚これらのルーチンは図には示されていないイグニッションスイッチの閉成により開始され、特に図4に示されたタイヤ空気圧推定ルーチンは所定の時間毎に繰り返し実行される。

【0031】まず図3に示された基準輪位置特定ルーチンのステップ10に於いては、基準輪の位置の特定が完了したか否かを示すフラグFが0にリセットされ、ステップ20に於いては車輪速度Vwiを示す信号等の読み込みが行われる。ステップ30に於いてはシフトポジションセンサ20よりの信号に基づき車輛が前進走行状態にあるか否かの判別が行われ、否定判別が行われたときにはステップ90へ進み、肯定判別が行われたときにはステップ40へ進む。

【0032】ステップ40に於いては左右前輪の車輪速度センサ12FL又は12FRよりの信号に基づき左前輪又は右前輪が路面の突起を乗り越したか否かの判別が行われ、否定判別が行われたときにはステップ20へ戻り、肯定判別が行われたときにはステップ50へ進む。ステップ50に於いては加減速度センサ16よりの信号に基づき加減速度センサが設けられた車輪が前輪の突起乗り越しと実質的に同時に路面の突起を乗り越したか否かの判別が行われ、否定判別が行われたときにはステップ110へ進み、肯定判別が行われたときにはステップ60へ進む。

【0033】ステップ60に於いては加減速度センサ16よりの電圧信号が正であるか否かの判別が行われ、肯定判別が行われたときには右前輪が基準輪である旨の判定が行われ、否定判別が行われたときにはステップ80に於いて左前輪が基準輪である旨の判定が行われる。

【0034】ステップ90及び100に於いて後輪についてそれぞれステップ40及び50と同様の判別が行われ、ステップ100に於いて否定判別が行われたときにはステップ60へ進み、肯定判別が行われたときにはステップ110へ進む。

【0035】ステップ110に於いてはステップ60の場合と同様の判別、即ち加減速度センサ16よりの電圧信号が正であるか否かの判別が行われ、肯定判別が行われたときにはステップ120に於いて左後輪が基準輪である旨の判定が行われ、否定判別が行われたときにはステップ130に於いて右後輪が基準輪である旨の判定が行われる。

【0036】ステップ140に於いてはマイクロコンピュータのRAMに格納されている基準輪の情報がステップ70、80、120又は130に於ける判定結果に更新されると共に、基準輪の位置の特定が完了したことが示されるようフラグFが1にセットされ、しかる後このルーチンを終了する。

【0037】尚ステップ40及び90に於ける車速に基づく突起乗り越しの判定に於いては、例えば車輪速度の時間微分値として車輪速度に基づく加減速度が演算され、該加減速度が車輛の通常の走行時には発生しない基準値以上である場合に、或いは車輪速度に基づく加減速度が基準値以上である状態が所定の時間以上継続する場合に、或いは車輪速度に基づく加減速度が基準値以上である状態が所定の時間以上継続し且つ車輪速度に基づく加減速度の微分値が基準値以上である場合に、突起乗り越しと判定されてよい。

【0038】同様にステップ50及び100に於ける加減速度センサよりの信号に基づく突起乗り越しの判定に於いては、例えば加減速度センサ16により検出された加減速度が車輛の通常の走行時には発生しない基準値以上である場合に、或いは検出された加減速度が基準値以上である状態が所定の時間以上継続する場合に、或いは検出された加減速度が基準値以上である状態が所定の時間以上継続し且つ検出された加減速度の微分値が基準値以上である場合に、突起乗り越しと判定されてよい。

【0039】また図4に示されたタイヤ空気圧推定ルーチンのステップ210に於いては、車輪速度 V_{wi} を示す信号等の読み込みが行われ、ステップ220に於いては四輪の車輪速度 V_{wi} の平均値として平均車輪速度 V_{wa} が演算され、ステップ230に於いては平均車輪速度 V_{wa} が例えば車速5km/hに対応する基準値 V_{wo} （正の定数）以上であるか否かの判別が行われ、否定判別が行われたときにはステップ210へ戻り、肯定判別が行われたときにはステップ240へ進む。

【0040】ステップ240に於いては基準輪位置判定ルーチンのステップ70、80、120、130に於いて判定されステップ140に於いて更新された基準輪の位置に応じて、下記の表2に示されている如く基準車輪速度 V_{wref} が設定されると共に、基準輪のタイヤ空気圧が空気圧センサ14により検出された値 P_{ref} に設定される。

【0041】

【表2】

| 基準輪 | 基準車輪速度 | タイヤ空気圧 |
|-----|----------------------|--------------------|
| 右前輪 | $V_{wref} = V_{wFR}$ | $P_{FR} = P_{ref}$ |
| 左前輪 | $V_{wref} = V_{wFL}$ | $P_{FL} = P_{ref}$ |
| 右後輪 | $V_{wref} = V_{wRR}$ | $P_{RR} = P_{ref}$ |
| 左後輪 | $V_{wref} = V_{wRL}$ | $P_{RL} = P_{ref}$ |

【0042】ステップ250に於いては下記の数1に従って基準輪以外の各輪のタイヤ空気圧 P_i が推定により演算される。

【数1】 $P_i = (V_{wref} / V_{wi}) * P_{ref}$

【0043】ステップ260に於いてはタイヤの空気圧 P_i が基準値 P_{oi} （正の定数）未満であるか否かの判別が行われ、否定判別が行われたときにはステップ210へ戻り、肯定判別が行われたときにはステップ270へ進

む。ステップ270に於いてはフラグFが1であるか否かの判別が行われ、肯定判別が行われたときにはステップ280に於いて警報装置22を作動させる制御信号が出力され、車輛の乗員に対しタイヤ空気圧が異常である旨の警報が発せられ、否定判別が行われたときにはステップ290に於いて基準輪の位置が特定されていない旨の表示と共に警報装置22が作動され、これにより車輛の乗員に対しタイヤ空気圧が異常である虞れが高い旨の警報が発せられる。尚ステップ260は全ての車輪のタイヤ空気圧 P_i について行われ、少なくとも一つの空気圧について肯定判別が行われたときにはステップ270が実行される。

【0044】かくしてこの実施形態の基準輪位置判定ルーチンに於いては、ステップ30～50、90、100に於いて図5及び図6との関連で上述した要領にて基準輪が前輪であるか後輪であるかの判定が行われ、ステップ30とステップ60又はステップ110との組合せにより基準輪が左右の車輪の何れであるかが判定されるので、基準輪の位置を正確に判定することができる。

【0045】またこの実施形態のタイヤ空気圧推定ルーチンに於いては、基準輪位置判定ルーチンにより特定された基準輪の位置に応じてステップ240に於いて基準輪の車輪速度 V_{wref} 及び基準輪のタイヤ空気圧が設定され、その設定に従ってステップ250に於いて基準輪以外の車輪のタイヤ空気圧が演算されるので、車輪のローテーションにより基準輪が移動されても、各輪のタイヤ空気圧を正確に演算し、タイヤ空気圧が異常であるか否かを正確に判定することができる。

【0046】特に図示の実施形態によれば、車輛の後進走行時にはステップ90及び100が実行され、車輪の後進時にも基準輪の位置の判定が実行されるので、車輛の後進時にも基準輪の位置を判定することができる。尚車輛の後進時には一般に車速が低く、またその走行距離も一般に短いので、ステップ30に於いて否定判別が行われたときにはステップ20へ戻り、ステップ90及び100が省略されてもよい。

【0047】また図示の実施形態によれば、ステップ270に於いて基準輪の位置の特定が完了しているか否かの判別が行われ、基準輪の位置の特定が完了していないときにはその旨の表示と共に警報が出力されるので、基準輪の位置の特定が完了していないときには警報が出力されない場合に比して、車輛の乗員は何れかのタイヤ空気圧が異常である虞れが高いことを確実に認識することができ、また基準輪位置の特定が行われていない旨の表示を伴わない警報が出力される場合には、基準輪の位置の特定が行われた上でタイヤ空気圧が異常であると判定されたことを確実に認識することができる。

【0048】更に図示の実施形態によれば、加減速度センサ16は空気圧センサ14と一体的に構成されているので、車輪のローテーションにより車輪が移動されて

も、これらのセンサが互いに別の車輪に取り付けられた状態になることを確実に防止し、これにより基準輪の位置を確実に特定することができる。

【0049】以上に於いては本発明を特定の実施形態について詳細に説明したが、本発明は上述の実施形態に限定されるものではなく、本発明の範囲内にて他の種々の実施形態が可能であることは当業者にとって明らかである。

【0050】例えば図示の実施形態に於いては、ステップ50及びステップ100に於いて否定判別が行われたときにはそれぞれそのままステップ110、60へ進むようになっているが、ステップ50及び100に於いて否定判別が行われたときには、車輛のホイールベースをHとして H/V_w に基づき車輛がホイールベースに相当する距離を走行する時間 Δt を演算し、車輪速度に基づき突起乗り越しの判定が行われた時点より実質的に Δt 経過後に加減速度に基づく突起乗り越しの判定が行われたか否かを判別し、否定判別が行われたときにはステップ20へ戻り、肯定判別が行われたときにはそれぞれステップ110、60へ進むよう修正されてもよい。

【0051】また図示の実施形態に於いては、ステップ70、80、120、130に於いて基準輪の位置の判定が行われたときにはそのままステップ140に於いて基準輪の位置の更新が行われるようになっているが、ステップ70、80、120、130に於いて基準輪の位置が同一の位置である旨の判定が所定の回数行われた場合に初めて基準輪の位置の更新が行われるよう構成されてもよい。

【0052】またステップ230の判別が肯定判別であるときには、フラグFが1であるか否かの判別、即ち基準輪の位置の特定が完了しているか否かの判別を行い、肯定判別が行われたときにはステップ240へ進み、否定判別が行われたときには各車輪間の車輪速度比に基づきタイヤ空気圧が最も低いと推定される車輪又はタイヤ空気圧が最も高いと推定される車輪を基準輪と判定するよう構成され、実施形態のステップ270及び290が省略されてもよい。

【0053】更にステップ230の判別が肯定判別であるときには、フラグFが1であるか否かの判別、即ち基準輪の位置の特定が完了しているか否かの判別を行い、肯定判別が行われたときにはステップ240へ進み、否定判別が行われたときには当技術分野に於いて周知の車輪速度に基づく外乱オブザーバ方式又はFFT（周波数

解析）方式により各輪のタイヤ空気圧を正確に推定するよう構成され、実施形態のステップ270及び290が省略されてもよい。特に外乱オブザーバ方式の場合には、推定される四輪のタイヤ空気圧の平均値が空気圧センサ14の検出値と一致するようオブザーバが初期化されてよい。

【0054】

【発明の効果】以上の説明より明らかである如く、本発明の請求項1の構成によれば、車輪のローテーションが行われることにより基準輪が移動されても、その移動後の基準輪の位置が特定されるので、基準輪について検出されるタイヤ空気圧と各輪の車輪速度とに基づき基準輪以外の車輪のタイヤ空気圧を正確に推定することができる。

【0055】また上述の請求項2の構成によれば、基準輪が左右輪の何れであるかが判定されると共に基準輪が前後輪の何れであるかが判定されるので、車輪のローテーションが行われることにより基準輪が移動されても、その移動後の基準輪の位置を正確に特定することができる。

【図面の簡単な説明】

【図1】本発明による車輛のタイヤ空気圧推定装置の一つの実施形態を示す概略構成図である。

【図2】空気圧センサ及び加減速度センサが設けられた車輪の回転加速度の方向と加減速度センサの出力電圧の符号との関係を示す説明図である。

【図3】実施形態に於ける基準輪位置判定ルーチンを示すフローチャートである。

【図4】実施形態に於けるタイヤ空気圧演算ルーチンを示すフローチャートである。

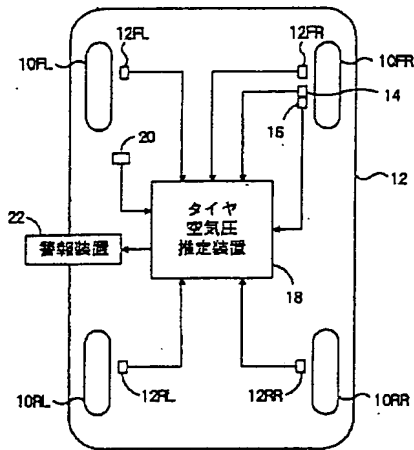
【図5】基準輪が前輪である場合に於いて車輛の前進中に前輪及び後輪がこの順に路面の突起を乗り越す状況を示す説明図（A）及びタイムチャート（B）である。

【図6】基準輪が後輪である場合に於いて車輛の前進中に前輪及び後輪がこの順に路面の突起を乗り越す状況を示す説明図（A）及びタイムチャート（B）である。

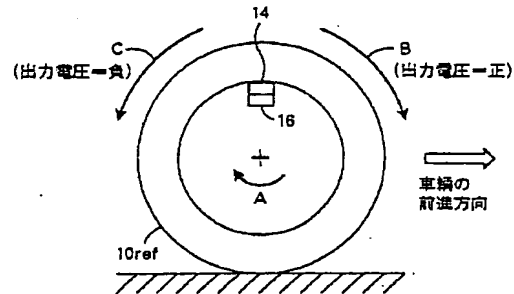
【符号の説明】

1 2 FL～1 2 RR…車輪速センサ
1 4…空気圧センサ
1 6…加減速度センサ
1 8…タイヤ空気圧推定装置
2 0…シフトポジションセンサ
2 2…警報装置

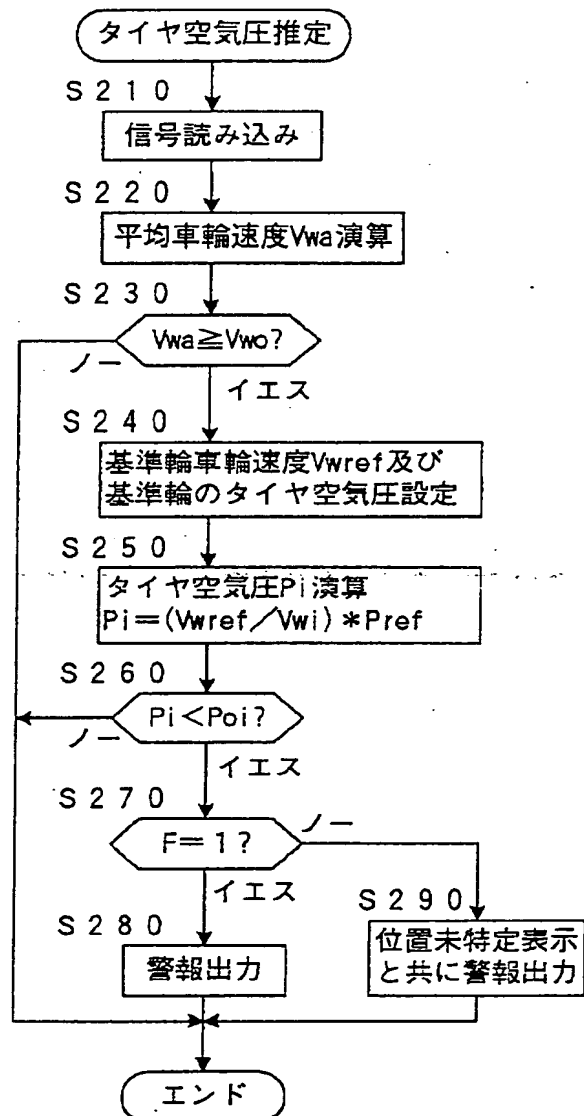
【図1】



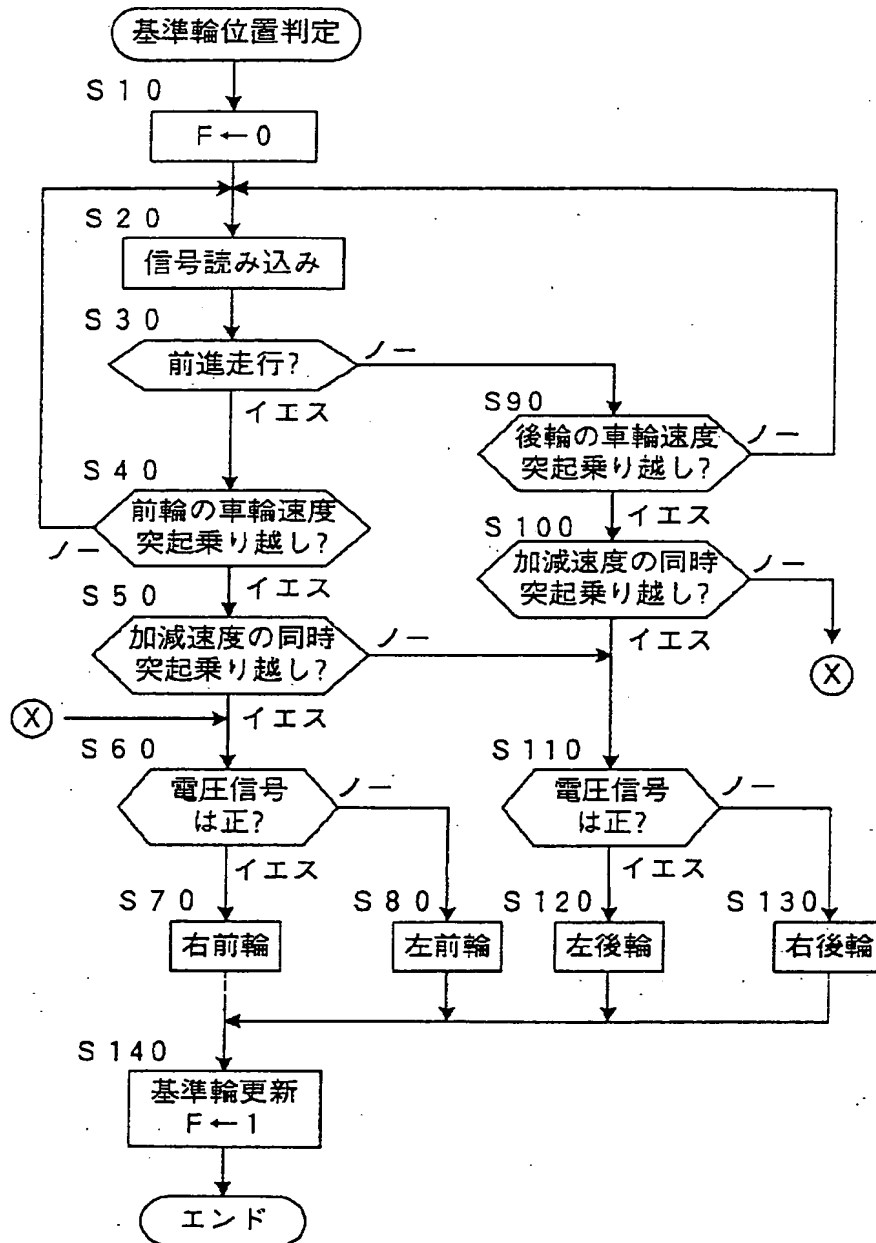
【図2】



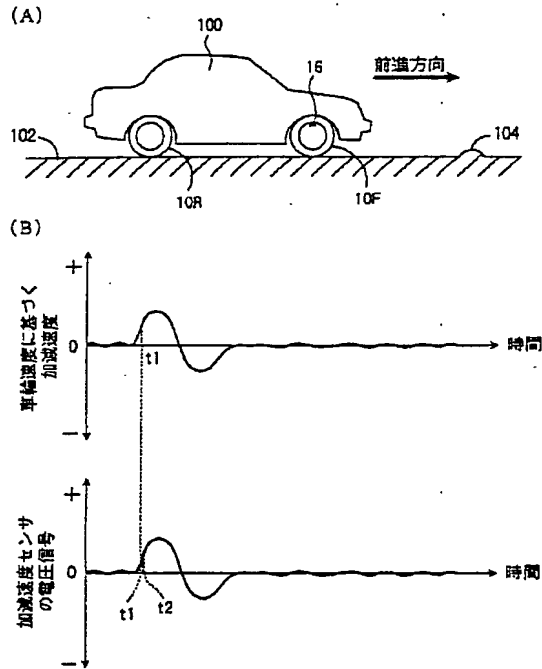
【図4】



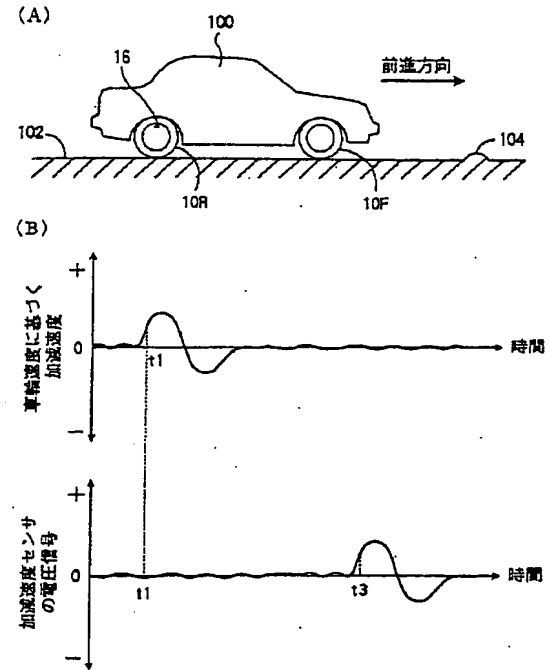
【図3】



【図5】



【図6】



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